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Mediating Effect and Suppressing Effect: Intermediate Mechanism of Urban Land Use Efficiency and Economic Development

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Abstract: The limited nature of land supply determines that improving land use efficiency is an inherent requirement for economic development. The aim of this study was to quantitatively examine its impact. Most current studies have explored the quantitative relationship between urban land use efficiency (ULUE) and economic development, but less attention has been given to the mechanism of action of both. In this study, we construct an analysis framework for the mechanism of ULUE in promoting economic development from three aspects: economic scale, economic structure, and economic quality, and we quantitatively investigate its impact on economic development and intermediate action mechanism through a mediating effect model on the basis of measuring ULUE by using a super-efficiency SBM-undesirable model. Based on the analysis of the panel data of 56 cities in the Yellow River Basin (YRB), the results show that, first, ULUE has formed an ideal positive driving effect on economic development, and its influence mechanism has obvious heterogeneity in cities with different geographical locations and resource endowments. Second, ULUE affects economic development through three channels: economic scale-up effect, economic structure optimization effect, and economic quality enhancement effect, and there are two different mechanisms of mediating effect and suppressing effect. Finally, variables such as investment intensity of urban construction land and social benefit act as suppressing effects, while variables such as economic output density of urban land, industrial structure, employment structure, economic benefit, and environmental benefit play partial mediating effects. These evidence-based findings can provide practical guidance for solving the dilemma of a lack of economic development momentum and inefficient land use in a country or region.

Keywords: heterogeneous effect; mechanism of action; super-efficiency SBM-undesirable model; mediating effect model; Yellow River Basin (YRB)

Citation: Zhong, X.; Li, Y. Mediating Effect and Suppressing Effect: Intermediate Mechanism of Urban Land Use Efficiency and Economic Development. *Land* **2023**, *12*, 1148. https://doi.org/10.3390/land12061148

Academic Editors: Hossein Azadi, Rando Värnik and Ants-Hannes Viira

Received: 16 April 2023
Revised: 24 May 2023
Accepted: 26 May 2023
Published: 30 May 2023

1. Introduction

Land resources are indispensable factors of production in the process of economic development, and land use permeates the whole process of human economic activities [1,2]. According to the World Bank, the total global economic volume grew rapidly from USD 3×10^{13} (in 1985) to USD 7.52×10^{13} (in 2015), and the total economic volume expanded nearly three times in 30 years, with an average annual growth rate of 3.11% [3]. Meanwhile, the global urban land area increased rapidly from 3.63×10^5 km^2 (in 1985) to 6.53×10^5 km^2 (in 2015), with a net expansion rate of 80% and an average of 9.69×10^3 km^2 of land converted into urban land each year [4]. During the early stage of economic development, land factor inputs provided a strong impetus for economic development [5,6]. However, it should be recognized that, due to the rigid constraint of limited total land supply, the growth of economic output, which mainly relied on large-scale land input, began

to be weak, and economic development entered a "transition period" [7,8]. Therefore, improving land use efficiency is a realistic choice to solve the problem of a lack of economic development momentum.

Since this study is concerned with the mechanism of action between ULUE and economic development, the empirical analysis is related to the literature on ULUE, economic development, and the interaction between the two. ULUE research has undergone continuous innovation and enrichment in terms of basic theory, index system, and measurement methods, and has formed a research framework and paradigm with diverse contents and methods [9]. The research objects have focused on compound or single land types such as urban construction land [10,11], industrial land [12,13], and logistics land [14]. The research content has mainly included the spatial-temporal pattern and driving mechanism of ULUE [15,16], spatial spillover effect, and their interaction mechanisms with other variables [17–19]. Research methods have followed two mainstream quantitative analysis methods, the non-parametric method such as a data envelopment analysis and the parametric method such as a stochastic frontier analysis [20–22]. The research scale has gradually changed from the spatial scale of a single prefecture-level city to medium and macro spatial scales such as economic zones and urban clusters [23]. Economic development has been a hot issue of academic interest, with research focusing on the mechanisms of its interaction with other variables. There are many factors that influence economic development, including urban renewal, urbanization, industrial structure, and population density [24–27]. However, relatively few studies have examined economic development from the perspective of land use efficiency.

Research on the interaction between ULUE and economic development has focused on three main aspects. First, the paths of ULUE change under different levels of economic development have been analyzed, and the quantitative relationship between the two has been revealed with the help of Kuznets curve, error correction model, and panel data model [28,29]. Second, the theoretical model of ULUE and economic development have been constructed by improving and extending the C-D production function and incorporating ULUE into total factor productivity to empirically test the impact of ULUE on economic development [30,31]. Third, the coupling relationship between ULUE and economic development has been quantitatively identified with the help of a coupling coordination degree model [32,33]. Empirical evidence suggests that ULUE has an important impact on economic development and is the main path to economic transformation. At the same time, ULUE can be limited by regional differences and differences in resource endowments [34], and there are significant differences in the mechanisms of its impacts on urban economic development. However, there are relatively few studies that have examined the impacts of ULUE on economic development from a heterogeneity perspective. In addition, the existing studies have focused on constructing mathematical and theoretical models to reveal the role of the relationship between ULUE and economic development. An analysis of their intrinsic intermediate action mechanism at the theoretical level is relatively insufficient, thus, failing to provide practical guidance for solving the dilemma of a lack of economic development momentum and inefficient land use in a country or region. The aim of this study is to provide empirical evidence for the mechanism of the action of ULUE in affecting economic development.

In September 2019, the ecological protection and high-quality development of the YRB was elevated to a major national strategy, which means that the YRB will face more severe pressure to improve quality and efficiency [35], and improving the land resource use efficiency is a realistic choice to solve the difficult problem of economic development and ecological protection in the YRB in the context of high-quality development [36]. However, the existing results have mainly been focused on the national level or regions with high economic development, while the YRB, as a typical area with complex and intertwined conflicts in China, has rarely been studied in the literature. Although some studies have taken the YRB as the study object, there is still a lack of research that has focused on the differences in geographic locations and resource endowments of cities in the YRB, and

has discussed the impact mechanisms of ULUE on economic development in a categorical manner. Does ULUE play a positive role in the economic development of the YRB? What are the differences in the mechanisms and pathways by which ULUE affects economic development in the YRB in different types of cities? Previous studies have shown that the economic development level is associated with economic scale, economic structure, and economic quality [37,38]. Do these three factors have a mediating effect between ULUE and economic development, and what are their corresponding effects? Here, we analyze these propositions through an empirical study.

For this study, we select the YRB as the research object. We construct an analytical framework of the action mechanism of ULUE affecting economic development from three perspectives: economic scale, economic structure, and economic quality, and we explain the action path of ULUE affecting economic development on the basis of measuring ULUE. The mediating mechanism of ULUE on economic development is examined through a mediating effect model, and the extent of the mediating effect is measured quantitatively. Compared with the existing studies, there are three marginal contributions of this study: (1) At the theoretical level, it constructs an analytical framework of the action mechanisms of ULUE affecting economic development, it reveals the inner mechanism of ULUE affecting economic development, and it provides a new academic perspective for the study of the action relationship between ULUE and economic development. (2) At the methodological level, the mediating effect and suppressing effect are introduced into the relationship between ULUE and economic development, providing a methodological reference for the study of the interaction between independent variables and dependent variables. (3) At the practical level, the mediating mechanism of ULUE on economic development is quantitatively examined, and the extent of the mediating effect is measured to provide a quantitative reference for the formulation of national or regional land use and economic development policies.

2. Theoretical Analysis and Research Hypotheses

2.1. Mediating Mechanism of ULUE and Economic Development

2.1.1. Economic Scale-Up Effect

The scale of land elements largely determines the scale of China's economic development, and a continuous and stable land supply is an important guarantee for the rapid growth of China's economy [39]. However, with the dramatic growth of land demand and the increasing scarcity of urban land resources, it is unsustainable to rely on the expansion of land scale. The improvement of ULUE makes the use of unit land elements more adequate and increases the economic supply of land, such as increasing the economic output density of urban land and the investment intensity of urban construction land, thus, providing material support for economic development [40]. At the same time, improved ULUE implies improvement of the allocation ratio and the allocation direction of land factors and other production factors. Under market conditions, land factors continuously flow from inefficient or low growth rate sectors to efficient or high growth rate sectors under the action of price leverage, and this change in land supply structure leads to the transfer and relative concentration of labor, capital, and technology factors, which promotes industries to realize scale and agglomeration benefits [41], and thus, expands the economic scale.

2.1.2. Economic Structure Optimization Effect

The improvement of ULUE implies optimization of urban land use structure [42]. Under the action of market mechanism and land value law, land use will consciously pursue profit maximization, and the land use structure will be adjusted continuously to achieve the best land use allocation to achieve optimal land use efficiency [43]. From the spatial perspective, the structure of land resource utilization largely determines the industrial layout and structure, and the process of land use structure transformation is essentially the process of spatial reconfiguration of urban industrial functions [44]. Therefore, optimization of land use structure is bound to promote rationalization of advanced industrial structure,

and then, promote transformation and upgrading of economic structure. At the same time, under the role of macro-control instruments such as land use planning and land use control, land use structure adjustment will drive the spatial distribution of employees to be continuously optimized, and the superposition of multiple effects will further improve the economic structure.

2.1.3. Economic Quality Enhancement Effect

Urban land use carries both the economic benefit and social benefit of economic and social development and improvement of people's lives, and the environmental benefit of ecological environment protection [45]. Currently, rough land use leads to serious waste of land resources, and also causes incalculable ecological losses and seriously restricts the improvement of economic quality [46]. Improving ULUE will release the utilization potential of stock, idle, and inefficient land, and then, improve the intensity of land development and utilization, and therefore, promote economical and intensive use of land [47]. Rationalization of land development and utilization intensity inevitably corresponds to higher economic, social, and environmental benefits. At the same time, the economical and intensive use of land inevitably promotes industries to reduce ecological and environmental costs through the conversion of old and new dynamics. Therefore, the improvement of ULUE is bound to promote the realization of "three benefits" and ultimately improve economic quality.

2.2. Differences in Geographic Locations and Resource Endowments of Cities in the YRB

The Comprehensive Plan for the YRB (2012–2030) divides cities in the YRB into upstream, midstream, and downstream cities based on their geographical locations. The YRB is an energy basin in China with rich resources including coal, oil, natural gas, and minerals [48]. The upstream area has several hydroelectric power stations that have been built due to the high terrain, many canyons, and rapid water flow. The midstream region is located in the Loess Plateau area and has rich coal resources; most resource-based cities with coal mining are located here, such as Yulin, Ordos, and Jincheng. In the downstream area, the terrain is gentler, mostly plains and hills, with rich natural gas and oil resources. Therefore, most of the cities in the downstream area are mainly engaged in oil and gas extraction, such as Puyang and Dongying, etc. In December 2013, the State Council officially released the National Sustainable Development Plan for Resource-Based Cities (2013–2020), which identified 262 resource-based cities. According to the content of this plan, there are 37 resource-based cities in the YRB, accounting for 25.4% of the total number of resource-based cities in China [49]. Resource-based cities are the types of cities that have emerged or developed from the exploitation and processing of natural resources, such as local minerals and forests that are used for leading industries [50]. As an important energy and resource supply base, resource-based cities have made important contributions to the industrialization process of the YRB [51]. However, due to the long-term uncontrolled exploitation of natural resources, a large number of resource-based cities are gradually evolving into resource-depleted cities, and the resulting unreasonable land use structure and low land use efficiency have become the main bottlenecks limiting the economic development of the YRB. Therefore, in this study, we divide the cities in the YRB into upstream, midstream, and downstream cities according to differences in their geographical locations. In addition, based on differences in resource endowments, the cities can be divided into resource-based cities and non-resource-based cities. A sample of cities in the YRB, in this study, is shown in Figure 1.

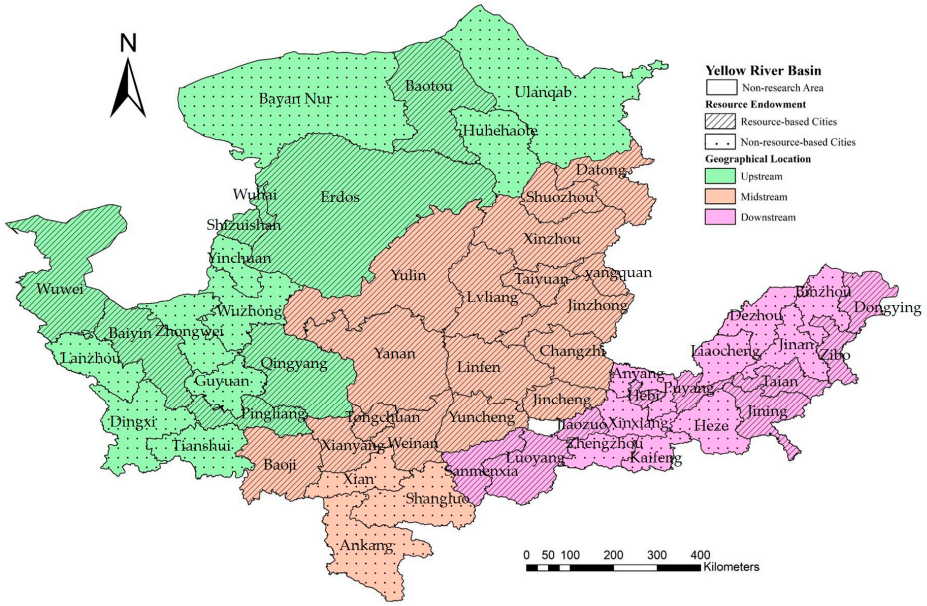

Figure 1. A sample of cities in the YRB.

The development as well as the rise and fall of cities in the YRB, in general, has followed the general laws of cities, and their unique resource endowment characteristics and land use structures determine their economic development with certain uniqueness [52]. Based on the above theoretical analysis, the theoretical framework of ULUE affecting economic development is constructed in this study, as shown in Figure 2. Meanwhile, in view of the significant differences in geographic locations and resource endowments of cities in the YRB, the following hypotheses to be tested are proposed.

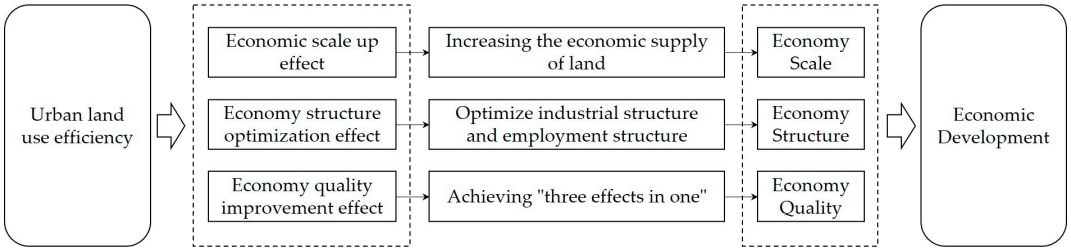

Figure 2. The influence mechanism of ULUE on economic development.

H1: *ULUE improvement has a positive effect on economic development.*

H2: *The impact of ULUE on economic development is heterogeneous across different types of cities. This study focuses on the differences in urban geographic locations and resource endowments, forming two inferences: (1) The impact of ULUE on economic development is heterogeneous across cities with different geographic locations (H2a). (2) The impact of ULUE on economic development is heterogeneous across cities with different resource endowments (H2b).*

H3: *Economic scale-up effect plays a mediating role in the relationship between ULUE and economic development. This study divides the economic scale-up effect into two indicators: economic output density of urban land and investment intensity of urban construction land, which form two inferences: (1) Economic output density of urban land plays a mediating role in the relationship between ULUE and economic development (H3a). (2) Investment intensity of urban construction land plays a mediating role in the relationship between ULUE and economic development (H3b).*

H4: *Economic structure optimization effect plays a mediating role in the relationship between ULUE and economic development. This study divides the economic structure optimization effect into two indicators: industrial structure and employment structure, which form two inferences: (1) Industrial structure plays a mediating role in the relationship between ULUE and economic development (H4a). (2) Employment structure plays a mediating role in the relationship between ULUE and economic development (H4b).*

H5: *Economic quality enhancement effect plays a mediating role in the relationship between ULUE and economic development. This study divides the economic quality enhancement effect into three indicators: economic benefit, social benefit, and environmental benefit, which also form three inferences: (1) Economic benefit plays a mediating role in the relationship between ULUE and economic development (H5a). (2) Social benefit plays a mediating role in the relationship between ULUE and economic development (H5b). (3) Environmental benefit plays a mediating role in the relationship between ULUE and economic development (H5c).*

3. Methodologies

3.1. Study Area

The YRB lies between latitudes 32° and 42° north and longitudes 96° and 119° east, with a width of about 1900 km from east to west and a length of about 1100 km from north to south. According to the "YRB Comprehensive Plan (2012–2030)", the YRB flows from west to east through nine provinces and regions, including Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shaanxi, Shanxi, Henan, and Shandong, with a basin area of 795,000 km^2 (including 42,000 km^2 of inland flow area). According to the 1995 administrative division statistics, the YRB involves a total of 69 regions (states, cities, and leagues). Considering data availability and completeness, 56 cities in the YRB were finally selected as the study units, as shown in Figure 3. According to the relevant data, the total population of the YRB is 421,801,500, which accounts for 30.05% of the total population of the country, and the GDP is CNY 247,407.66 billion, which accounts for 25.11% of the national GDP. With a land area of 27.3% of the country, the YRB supports 1/3 of the population and contributes 1/4 of the total economic output.

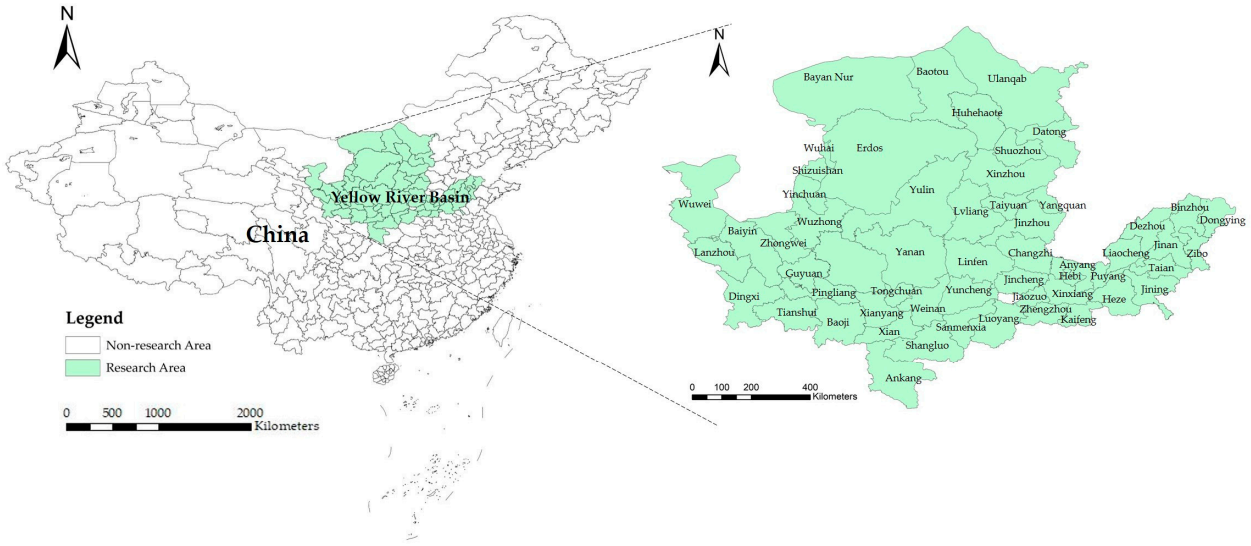

Figure 3. Location map of the study area.

The YRB is an important economic belt spanning the three regions of eastern, central, and western China, and is also an important ecological barrier in China. The YRB, as a whole, is currently in the middle-to-late industrialization stage, with an urbanization rate lower than the national average. The expansion of urban construction land is an inevitable trend for economic development in the coming period, i.e., land use will have an important

impact on its long-term economic development. However, land use data show that the intensity of land development in the YRB (8.53%) is higher than the national average (7.02%), while the economic output per unit of land (CNY 151.14 million/hm^2) is significantly lower than the national average (CNY 222.20 million/hm^2), and the development pattern characterized by inefficient land inputs has hindered the economic development of the YRB to some extent [36]. Therefore, at this critical period of economic transformation and spatial reshaping facing the YRB, improving land use efficiency is the way to solve the dilemma of inefficient land use and to achieve economic transformation.

3.2. Model Construction

Based on the previous theoretical analysis, it is known that ULUE has an indirect path of action on economic development. However, a further empirical test analysis is needed. In order to test whether ULUE has an impact on economic development through three mediators: economic scale-up effect, economic structure optimization effect, and economic quality enhancement effect, in this study, we referred to the stepwise regression test for mediating effect proposed by Baron for empirical analysis [53], and constructed the following stepwise regression equation for testing:

$$\ln Eco_{it} = \alpha_0 + \alpha_1 ULUE_{it} + \alpha_2 X_{it} + \varepsilon_{it} \quad (1)$$

$$M_{it} = \beta_0 + \beta_1 ULUE_{it} + \beta_2 X_{it} + \mu_{it} \quad (2)$$

$$\ln Eco_{it} = \theta_0 + \theta_1 ULUE_{it} + \theta_2 M_{it} + \theta_3 X_{it} + v_{it} \quad (3)$$

where ln*Eco* is the explained variable economic development level; ULUE is the core explanatory variable; *X* is a series of control variables, mainly including local government financial support, urban population density, urbanization level, and urban transportation development level; *M* is the mediator, mainly including economic scale-up effect, economic structure optimization effect, and economic quality enhancement effect; α_0, α_1, α_2, β_0, β_1, β_2, θ_0, θ_1, θ_2, and θ_3 are the parameters of the model; ε, μ, and v are the random disturbance terms of the model; i and t denote cities and years, respectively.

The estimation results of the mediating effect model were tested in combination with the available research results [54], and the steps were as follows:

(1) The regression coefficient α_1 of Equation (1) is tested. If it is significant, it indicates that ULUE improvement significantly contributes to the improvement of the economic development level.

(2) The regression coefficient β_1 of Equation (2) is tested, and if it is significant, it indicates that ULUE has an effect on economic scale, economic structure, and economic quality as mediators.

(3) The regression coefficients θ_1 and θ_2 of Equation (3) are tested, and if both are significant, they indicate that there is a partial mediating effect, i.e., ULUE affects economic development through mediators. If the coefficient θ_1 is not significant, it indicates that there is a full mediating effect, i.e., ULUE can affect economic development only through mediators. If the coefficient θ_2 is insignificant, it indicates that there is no mediating effect, and the Sobel test can be further used to verify again.

(4) The Sobel test is conducted, and if the statistic Z passes the test, there is a mediating effect, and vice versa, there is no mediating effect. It should be noted that the coefficient β_1 and the coefficient θ_2 are subject to the Sobel test as long as one of them is insignificant.

In addition, in order to investigate the magnitude of the economic scale-up effect, economic structure optimization effect, and economic quality enhancement effect on the pathways of ULUE affecting economic development, in this study, we needed to calculate the extent of their mediating effects. When θ_1 and $\beta_1\theta_2$ have the same sign, the degree of mediating effect is $\beta_1\theta_2/(\beta_1\theta_2 + \theta_1)$; when θ_1 and $\beta_1\theta_2$ have different signs, that is,

the mediating effect is negative, which is called suppressing effect, and the degree of suppressing effect is $|\beta_1\theta_2/\theta_1|$.

3.3. Variable Description

3.3.1. Explained Variable

The explained variable in this study is the economic development level, and GDP per capita was chosen to characterize it with reference to existing studies [55,56] and measured logarithmically. Generally, the higher the GDP per capita, the higher the social welfare level and the more developed the economic development level; therefore, the choice of this indicator can better reflect the actual economic development of the YRB and can improve the persuasiveness of the research findings. The GDP was also used as an alternative explained variable for the robustness test and is measured logarithmically.

3.3.2. Core Explanatory Variable

In 1978, Charnes and other scholars were the first to propose the data envelopment analysis (DEA) method for measuring the relative effectiveness of multi-input and multi-output decision units, which has been widely used and expanded in the research fields of efficiency evaluation. Limited by the fact that the traditional DEA model could not achieve the efficiency evaluation of non-desired outputs and had the problem of input-output variable relaxation, Tone successively proposed the SBM-undesirable model and the super-efficiency SBM-undesirable model, which effectively solved the problem of non-desired output evaluation and variable relaxation [57]. In view of this, the ULUE values, in this study, were measured using the super-efficiency SBM-undesirable model that considered non-desired output with constant returns to scale under the input perspective, while the measurement results of the SBM-undesirable model (*ULUE2*) were used as the alternative core explanatory variables for robustness testing.

Suppose there are n decision-making units (DMU, n = 1, 2, . . . , N) and each DMU contains a number of inputs, desired outputs, and non-desired outputs set as m, l, and h, respectively, the measurement equations are shown in Equations (4) and (5) as:

$$\min\theta^* = \frac{1+\frac{1}{m}\sum_{m=1}^{M}\left(s_m^x/s_{jm}^t\right)}{1-\frac{1}{l+h}\left(\sum_{l=1}^{L}\left(s_l^y/y_{jl}^t\right)+\sum_{h=1}^{H}\left(s_h^b/b_{jh}^t\right)\right)} \tag{4}$$

$$\text{s.t.}\begin{cases} x_{jm}^t \geq \sum\limits_{j=1.j\neq 0}^{n}\lambda_j^t x_{jm}^t + s_m^x \\ y_{jl}^t \geq \sum\limits_{j=1.j\neq k}^{n}\lambda_j^t y_{jl}^t + s_l^y \\ b_{jh}^t \geq \sum\limits_{j=1.j\neq k}^{n}\lambda_j^t b_{jh}^t + s_h^b \\ \lambda_j^t \geq 0, s_m^x \geq 0, s_l^y \geq 0, j = 1,\ldots,n \end{cases} \tag{5}$$

where θ^* is the ULUE value; x_j^t, y_j^t, and b_j^t denote the input, desired output, and undesired output values of DMUj in period t, respectively; s_m^x, s_l^y, and s_h^b are the slack vectors of input, desired output, and undesired output, respectively; λ is the weight vector.

Referring to existing studies [58,59], the input indicators were selected as land, capital, and labor inputs for urban construction land area, urban fixed asset input, and the number of employees in the second and third industries, respectively. The values added of the second and third industries were selected to characterize the economic benefit output, the local fiscal revenue to characterize the social benefit output, and the green space area to characterize the ecological and environmental benefit output. In order to comprehensively measure the non-desired outputs caused by the urban land use process, two non-desired output indicators, i.e., industrial sulfur dioxide emissions and industrial wastewater emissions, were selected. The ULUE input-output index system is shown in Table 1.

Table 1. The ULUE input-output index system.

Variable Type	Dimension	Definition (Unit)
Input	Land	Urban construction land area (km^2)
	Capital	Total social fixed asset investment (million yuan)
	Labor	Number of employees in secondary and tertiary industries (million people)
Desired output	Economic benefit	Value added of secondary and tertiary industries (million yuan)
	Social benefit	Local fiscal revenue (million yuan)
	Environmental benefit	Green space area (hectares)
Non-desired output		Industrial wastewater discharge (million tons)
		Industrial sulfur dioxide emissions (million tons)

3.3.3. Mediators

The theoretical analysis, in this study, explored the economic scale-up effect, economic structure optimization effect, and economic quality enhancement effect of ULUE, while economic development was related to economic scale, economic structure, and economic quality. Based on this, in this study, we analyzed the mediating effect of ULUE on economic development under the three dimensions of economic scale, economic structure, and economic quality. Although there are many factors affecting these three dimensions, in this study, we combined a theoretical analysis with reference to existing studies [37,38], and only selected some indicators which had a strong correlation with ULUE as the mediators. The selection and description of mediators are shown in Table 2.

Table 2. Mediator selection and description.

First-Level Indicator	Second-Level Indicator	Measurement Method (Unit)	Variable Symbol
Economic scale	Economic output density of urban land	The output value of secondary and tertiary industries per unit of urban construction land area (million yuan/km^2)	lnScale1
	Investment intensity of urban construction land	The fixed asset investment per unit of urban construction land area (million yuan/km^2)	lnScale2
Economic structure	Industrial structure	The proportion of tertiary industry output value to GDP (%)	Structure1
	Employment structure	The proportion of tertiary industry employees to all employees (%)	Structure2
Economic quality	Economic benefit	The average wage of employees on the job (yuan)	lnBenefit1
	Social benefit	The ratio of urban and rural residents' income (-)	Benefit2
	Environmental benefit	Wastewater emissions per unit of GDP (tons/million yuan)	lnBenefit3

3.3.4. Control Variable

In addition to being influenced by ULUE, the dynamics of economic development are also closely related to local government financial support, urban population density, urbanization level, and urban transportation development level. In order to mitigate the estimation bias caused by the omission of variables as much as possible, in this study, we incorporated a set of city-level control variables in the empirical model by combining existing research results [26,34], specifically: (1) local government financial support (lnGov), characterized by per capita local government general financial expenditure; (2) urban population density (lnPop), characterized by the number of resident population per unit urban built-up area; (3) urbanization level (lnUrb), characterized by the proportion of

urban population to total population; (4) urban transportation development level (lnTra), characterized by per capita road area.

3.4. Data Source

To comprehensively examine the accessibility and continuity of data, in this study, we identified the study sample as 56 cities in the YRB, and some cities (regions and autonomous regions) with serious data deficiencies were excluded from the study. According to the Comprehensive Plan of the YRB (2012–2030), the sample cities were divided into 18 upstream cities, 20 midstream cities, and 18 downstream cities. Meanwhile, based on the National Sustainable Development Plan for Resource-based Cities (2013–2020), the sample cities were divided into 34 resource-based cities and 22 non-resource-based cities. The study period was determined to be 2002–2020, and the data used included urban land use data, relevant socioeconomic data, and environmental pollution data, from the China Urban Construction Statistical Yearbook, the China Urban Statistical Yearbook, and the statistical yearbooks of provinces and cities. Missing data of individual years were supplemented and verified by the statistical bulletin of each city.

4. Results Analysis

4.1. ULUE Spatial-Temporal Characteristics Analysis

4.1.1. Time Series Characteristics

The super-efficiency SBM-undesirable model was used to measure the ULUE in the YRB during the study period by constructing an input-output index system (Figure 4). The mean values of ULUE in the YRB fluctuate and increase from 0.677 (in 2002) to 0.794 (in 2020), and the mean value of ULUE shows a significant change with the year 2013 as the boundary. The mean values of ULUE increased rapidly from 0.645 (in 2013) to 0.794 (in 2020) due to the release of the "Comprehensive Plan for the YRB (2012–2030)", which has played important roles in promoting the economical and intensive use of land in the YRB and the in-depth promotion of ecological civilization construction. Downstream cities have the highest land use efficiency, followed by upstream cities; the land use efficiency of midstream cities is relatively low. The land use efficiency of resource-based cities is higher than that of non-resource-based cities before 2015, while non-resource-based cities have higher land use efficiency after 2015.

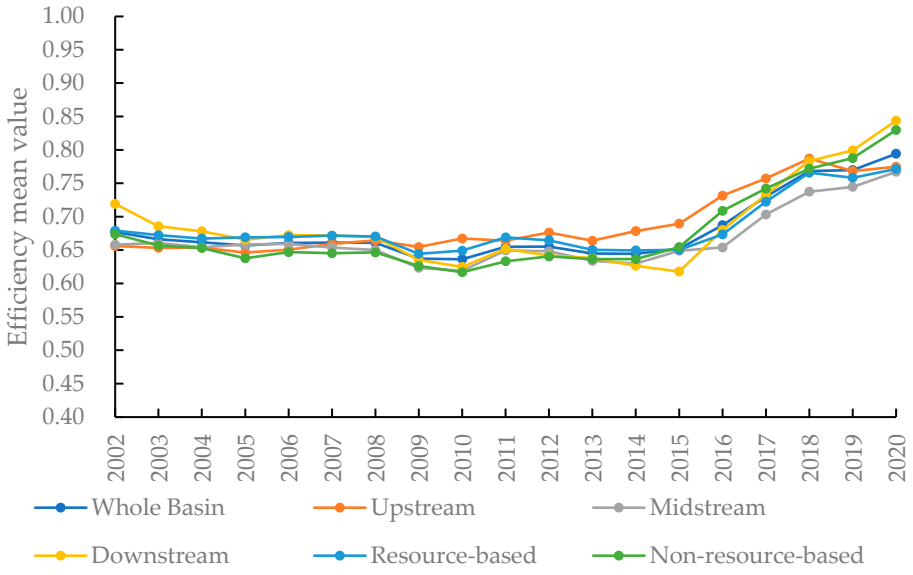

Figure 4. Trends in mean values of ULUE in the YRB from 2002 to 2020.

4.1.2. Spatial Distribution Characteristics

The Arc GIS 10.7 software was used to classify the spatial distribution into low efficiency, medium-low efficiency, medium efficiency, medium-high efficiency, and high efficiency, according to the natural breakpoint method, and seven time points were selected in 2002, 2005, 2008, 2011, 2014, 2017, and 2020 to draw the spatial distribution of ULUE in the YRB (Figure 5). During the study period, the ULUE in the YRB mainly shows two spatial distribution characteristics. First, the distribution characteristics of high-value cities and low-value cities are obvious. High-value cities are mainly clustered in the downstream area and part of the upstream area of the YRB, while low-value cities are mainly clustered in the middle and upstream areas of Gansu. The cities of Jinan, Zibo, and Dongying in the downstream area have significantly improved land use efficiency, and their ULUE is higher than that of other cities in the YRB. Some cities in upstream Gansu and Shaanxi have lower land use efficiency and the gap with other cities in the basin is too large, while the ULUE of Hohhot, Erdos, and Shizuishan, which are also in the upstream, is significantly higher than that of other cities in the basin. Second, the radiation effect among regional cities is revealed. During the study period, the number of cities with medium-high efficiency value increased from 0 (in 2002) to 8 (in 2020), and the number of cities with high efficiency value increased from 1 (in 2002) to 10 (in 2020), showing the trend that cities with high efficiency value radiate and drive their neighboring cities to gradually improve ULUE.

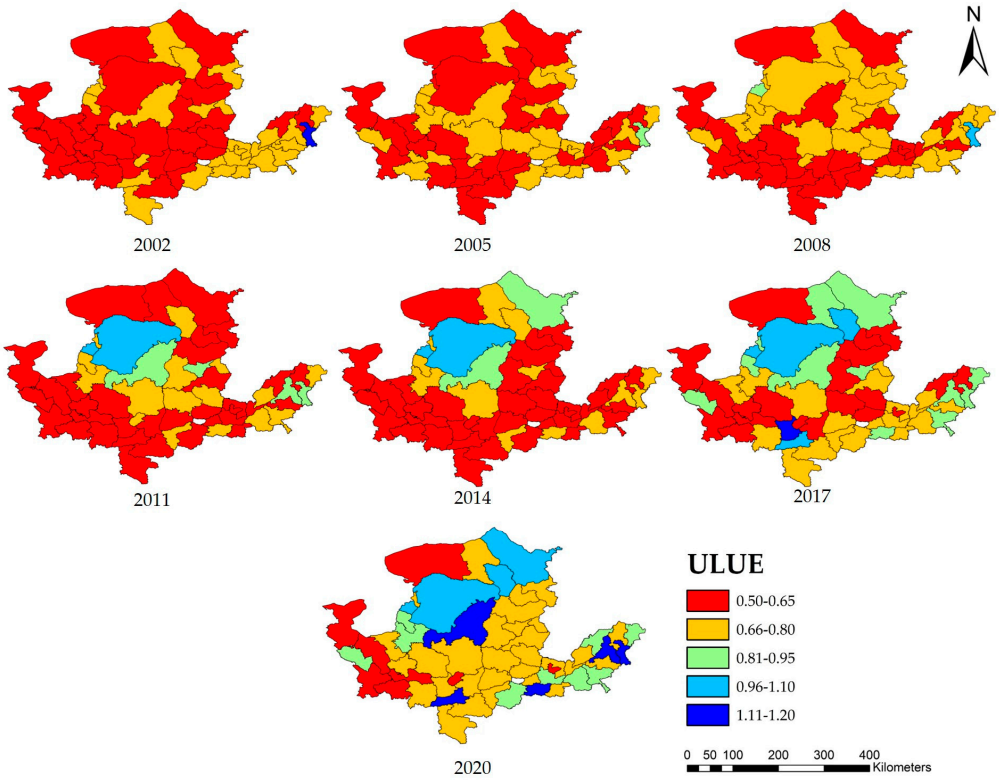

Figure 5. Spatial distribution pattern of ULUE in the YRB from 2002 to 2020.

4.2. Analysis of the Intermediate Action Mechanism of ULUE on Economic Development

4.2.1. Baseline Regression Analysis

In this study, according to the process of mediating effect test, the impact of ULUE on economic development is first estimated based on the benchmark model of Equation (1), which is used to determine whether the conditions of mediating effect test are available. All estimates in this study are determined by using the Hausman test results to determine the model selection, and the two-way fixed effects model is selected to examine the impact of ULUE on economic development after the test. In addition, in order to reduce the degree of multicollinearity, the model estimation is carried out using the stepwise regression method,

and the specific regression results are shown in Table 3. Model (1) is the regression result without adding control variables, and Models (2)–(5) are the results of stepwise adding control variables, respectively. From Model (1), the estimated coefficient of ULUE is significant and positive at the 1% statistical level. A comparison of Model (2) to Model (5) shows that the estimated coefficients of ULUE with the stepwise addition of control variables are all significant and positive at the 1% statistical level, with only some changes in the magnitude of the coefficients, indicating that improving ULUE is beneficial to promoting economic development in the YRB, thus, verifying H1.

Table 3. Baseline regression results.

Variable	(1)	(2)	(3)	(4)	(5)
ULUE	0.4660 ***	0.3450 ***	0.3240 ***	0.4040 ***	0.3980 ***
	(0.0686)	(0.0604)	(0.0600)	(0.0599)	(0.0599)
lnGov		0.3340 ***	0.3410 ***	0.2930 ***	0.2940 ***
		(0.0191)	(0.0190)	(0.0199)	(0.0199)
lnPop			0.0308 ***	0.0341 ***	0.0318 ***
			(0.0070)	(0.0069)	(0.0070)
Indus				0.2420 ***	0.2370 ***
				(0.0355)	(0.0356)
lnUrb					0.0277
					(0.0177)
lnTra	8.4430 ***	6.6200 ***	6.3820 ***	5.7490 ***	5.7300 ***
	(0.0514)	(0.114)	(0.1250)	(0.1530)	(0.1540)
Constant	0.4660 ***	0.3450 ***	0.3240 ***	0.4040 ***	0.3980 ***
	(0.0686)	(0.0604)	(0.0600)	(0.0599)	(0.0599)
Time	Control	Control	Control	Control	Control
City	Control	Control	Control	Control	Control
R^2	0.945	0.958	0.959	0.960	0.960
N	1064	1064	1064	1064	1064

Note: Standard error values in parentheses; *** is 1% significant level.

In terms of each control variable, local government financial support has a significant positive effect on economic development, and an increase in financial support from the city government directly promotes economic development. Urban population density has a significant positive impact on economic development, and an increase in urban population concentration level has a more positive scale-up effect on its own development by guiding the concentration of resource factors, which shows a significant positive impact on economic development. The urbanization level has a significant positive impact on economic development. With the continuous promotion of new urbanization construction in the YRB, the urbanization level is rapidly increasing, which directly drives the economic development level. The impact of the urban transportation development level on economic development is not significant, and the relatively lagging transportation development in the YRB hinders the economic development level to a certain extent.

4.2.2. Heterogeneity Regression Analysis

(1) Analysis of grouping results based on differences in geographic location

Table 4 reports the results of grouped regressions based on geographic location differences, with significant positive impacts on midstream and downstream cities and insignificant impacts on upstream cities, indicating that the impacts of ULUE on economic development differ significantly across cities in different geographic locations, thus, validating H2a. The impacts of ULUE on the economic development of cities in different geographical locations is significantly different, with significant positive impacts on midstream and downstream cities, but not on upstream cities. In contrast, the industrial structure of upstream cities is mostly dominated by secondary industry, which often brings about rapid expansion of urban land and environmental pollution; a series of conflicts

caused by economic development and ecological environmental protection are still concentrated in upstream cities, which, to a certain extent, hinders the positive driving effect of ULUE on economic development. The midstream cities have two advantages of population scale and market potential and continuously revitalized idle land and low-utility land, which effectively promote economic development. Downstream cities generally have higher land use efficiency than that of other cities in the basin, which has a greater driving effect on economic development.

Table 4. Estimation results of grouping models based on differences in geographic locations.

Variable	(1) Full Sample	(2) Upstream	(3) Midstream	(4) Downstream
ULUE	0.3980 ***	0.1260	0.7440 ***	0.2260 **
	(0.0599)	(0.1170)	(0.0928)	(0.0911)
lnGov	0.2940 ***	0.3060 ***	0.2090 ***	0.3630 ***
	(0.0199)	(0.0459)	(0.0286)	(0.0409)
lnPop	0.0318 ***	0.0404 ***	0.0162	−0.0328 **
	(0.0070)	(0.0118)	(0.0116)	(0.0160)
lnUrb	0.2370 ***	0.2720 ***	0.4190 ***	−0.0087
	(0.0356)	(0.0606)	(0.1000)	(0.0503)
lnTra	0.0277	0.1270 ***	−0.1090 ***	0.0697 ***
	(0.0177)	(0.0349)	(0.0277)	(0.0254)
Constant	5.7300 ***	5.1570 ***	5.6820 ***	6.9950 ***
	(0.1540)	(0.2980)	(0.3510)	(0.2690)
Time	Control	Control	Control	Control
City	Control	Control	Control	Control
R^2	0.960	0.956	0.968	0.979
N	1064	342	380	342

Note: Standard error values in parentheses; ***, ** are 1%, 5% significant levels, respectively.

By analyzing the results of control variables, it is found that, in the upstream city grouping, local government financial support, urban population density, urbanization level, and urban transportation development level are all significantly positive. In the midstream cities grouping, local government financial support and urbanization level are both significantly positive, while urban transportation development level shows an opposite effect. In the downstream city grouping, local government financial support and urban transportation development level are significantly positive, while urban population density shows an opposite effect. Overall, midstream cities show a positive effect on economic development with increased financial support from city governments, coupled with an increasing level of urbanization. However, it should be noted that the transportation development of midstream cities is relatively lagging behind, which has a negative impact on economic development. The downstream cities have a better foundation of economic development, which, together with the continuous improvement of urban transportation infrastructure construction, presents a positive impact on economic development. However, it should be noted that there are obvious differences in the levels of population concentration in the downstream cities, and the environmental pollution and other phenomena brought about by population concentration are more prominent, which has a negative impact on economic development.

(2) Analysis of grouping results based on differences in resource endowments.

Table 5 reports the results of grouped regressions based on resource endowment differences, with significant positive impacts on resource-based cities and insignificant impacts on non-resource-based cities, indicating that the impacts of ULUE on economic development differ significantly across cities in different resource endowments, thus, validating H2b. The impacts of ULUE on the economic development of cities with different resource endowments is significantly different, with significant positive impacts on resource-based cities and insignificant impacts on non-resource-based cities. In contrast, resource-based cities in the YRB are characterized by high numbers and large differences in socioeconomic

development levels, and most of them are mature cities, where low land use efficiency has become a major bottleneck limiting their economic development, and improving ULUE is an inevitable choice for their economic development. Due to the low level of resource endowment, the resource endowment status of non-resource-based cities has a low dependence on natural resources in the process of economic development, and therefore, ULUE has not had a significant impact on economic development.

Table 5. Estimation results of grouping models based on differences in resource endowments.

Variable	(1) Full Sample	(2) Resource-Based	(3) Non-Resource-Based
ULUE	0.3980 ***	0.6120 ***	0.0112
	(0.0599)	(0.0710)	(0.1080)
lnGov	0.2940 ***	0.2170 ***	0.4240 ***
	(0.0199)	(0.0242)	(0.0345)
lnPop	0.0318 ***	0.0147	0.0367 ***
	(0.0070)	(0.0094)	(0.0099)
lnUrb	0.2370 ***	0.1150 **	0.2500 ***
	(0.0356)	(0.0471)	(0.0548)
lnTra	0.0277	−0.0308	0.0604 **
	(0.0177)	(0.0246)	(0.0254)
Constant	5.7300 ***	6.7660 ***	4.9380 ***
	(0.1540)	(0.2020)	(0.2690)
Time	Control	Control	Control
City	Control	Control	Control
R^2	0.960	0.962	0.965
N	1064	646	418

Note: Standard error values in parentheses; ***, ** are 1%, 5% significant levels, respectively.

By analyzing the results of control variables, it is found that the levels of local government financial support and urbanization are significantly positive in the grouping of resource-based cities. In the grouping of non-resource-based cities, the levels of local government financial support, urban population density, urbanization, and urban transportation development are all significantly positive. Overall, resource-based cities are gradually evolving into resource-depleted cities, and the resulting industrial structure imbalance has become the main bottleneck restricting the transformation of resource-based cities; the unreasonable industrial structure has brought negative effect on economic development. An increase in local government financial support and an increase in the urbanization level are conducive to the promotion of industrial structure upgrading, and thus, economic development. The increasing levels of population concentration and urbanization in non-resource-based cities, coupled with the continuous improvement of urban transportation infrastructure construction, show a positive impact on economic development.

4.2.3. Robustness and Endogeneity Tests

To further test the robustness and endogeneity issues of the previous main findings, in this study, we conducted multiple robustness tests by replacing variables and instrumental variables methods, respectively. (1) For replacement of the explained variable, the model was tested by replacing the explained variable with the GDP. (2) For replacement of the core explanatory variable, the SBM-undesirable model based on DEA was used to measure the land use efficiency value of each city in the YRB, and the model was estimated by replacing the core explanatory variable to test the robustness of the model. (3) For the instrumental variable method, due to possible omission of variables and considering the possible two-way causality between ULUE and economic development, the empirical test was conducted again by constructing an instrumental variable model. ULUE with a one-period lag was incorporated into the model as an instrumental variable to test for possible endogeneity.

Models (1)–(3), in Table 6, report the model estimation results after replacing the explained variable, replacing the core explanatory variable, and dealing with endogeneity, respectively. Considering the length of this article, the results for the control variables are not reported. The results show that after the robustness test and the removal of possible partial endogeneity, the significance and sign of the coefficients of the core explanatory variable does not change significantly, thus, indicating the strong robustness of the baseline regression results.

Table 6. Robustness test results.

Variable	(1)	(2)	(3)
ULUE	0.6660 ***		0.7320 ***
	(0.0553)		(0.1100)
ULUE2		0.1320 **	
		(0.0523)	
Constant	12.6400 ***	5.906 ***	2.223 ***
	(0.1420)	(0.1550)	(0.1900)
Control variable	Yes	Yes	Yes
Time	Control	Control	Control
City	Control	Control	Control
R^2	0.968	0.959	0.828
N	1064	1064	1008

Note: Standard error values in parentheses; ***, ** are 1%, 5% significant levels, respectively.

4.2.4. Analysis of the Action Mechanism

As can be seen from the baseline regression results, the mediating effect test can be continued. Combined with the theoretical analysis mentioned above, ULUE has impacts on economic development through economic scale-up effect, economic structure optimization effect, and economic quality enhancement effect. Based on this, in this study, we test the three mediating effects one-by-one according to Equations (2) and (3). The test results are shown in Tables 7–9.

Table 7. Mediating effect test of economic scale-up of ULUE on economic development.

Variable	Economic Output Density of Urban Land		Investment Intensity of Urban Construction Land	
	(1) lnScale1	(2) lnEco	(3) lnScale2	(4) lnEco
ULUE	0.4720 ***	0.2430 ***	−1.0260 ***	0.5180 ***
	(0.0918)	(0.0525)	(0.1300)	(0.0598)
lnScale1		0.3290 ***		
		(0.0180)		
lnScale2				0.1160 ***
				(0.0142)
Constant	8.9340 ***	2.786 ***	9.2880 ***	4.6510 ***
	(0.2360)	(0.2080)	(0.3340)	(0.1990)
Control variable	Yes	Yes	Yes	Yes
Time	Control	Control	Control	Control
City	Control	Control	Control	Control
R^2	0.838	0.971	0.862	0.963
N	1064	1064	1064	1064
Mediating effect/Suppressing effect		Significantly, 38.99% of the total		Significantly, 22.98% of the total

Note: Standard error values in parentheses; *** is 1% significant level.

Table 8. Mediating effect test of economic structure optimization of ULUE on economic development.

Variable	Industrial Structure		Employment Structure	
	(1) Structure1	**(2) lnEco**	**(3) Structure2**	**(4) lnEco**
ULUE	−0.0320 **	0.3690 ***	−0.0211	0.3870 ***
	(0.0158)	(0.0584)	(0.0207)	(0.0589)
Structure1		−0.9040 ***		
		(0.1180)		
Structure2				−0.5560 ***
				(0.0906)
Constant	0.4450 ***	6.1320 ***	0.7720 ***	6.1590 ***
	(0.0405)	(0.1580)	(0.0531)	(0.1660)
Control variable	Yes	Yes	Yes	Yes
Time	Control	Control	Control	Control
City	Control	Control	Control	Control
R^2	0.654	0.963	0.278	0.962
N	1064	1064	1064	1064
Mediating effect/Suppressing effect		Significantly, 7.27% of the total		Not significant, passed Sobel test, 2.94% of total

Note: Standard error values in parentheses; ***, ** are 1%, 5% significant levels, respectively.

Table 9. Mediating effect test of economic quality enhancement of ULUE on economic development.

Variable	Economic Benefit		Social Benefit		Environmental Benefit	
	(1) lnBenefit1	**(2) lnEco**	**(3) Benefit2**	**(4) lnEco**	**(5) lnBenefit3**	**(6) lnEco**
ULUE	0.0483	0.3830 ***	0.4750 ***	0.4820 ***	−0.4290 **	0.3620 ***
	(0.0328)	(0.0591)	(0.0777)	(0.0595)	(0.1900)	(0.0579)
lnBenefit1		0.3260 ***				
		(0.0574)				
Benefit2				−0.1760 ***		
				(0.0240)		
lnBenefit3						−0.0856 ***
						(0.0097)
Constant	8.2580 ***	3.0340 ***	3.9150 ***	6.4200 ***	3.655 ***	6.0430 ***
	(0.0840)	(0.4980)	(0.1990)	(0.1770)	(0.4880)	(0.1520)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Time	Control	Control	Control	Control	Control	Control
City	Control	Control	Control	Control	Control	Control
R^2	0.987	0.962	0.616	0.963	0.754	0.963
N	1064	1064	1064	1064	1064	1064
Mediating effect/Suppressing effect		Not significant, passed Sobel test, 3.95% of total		Significantly, 17.34% of the total		Significantly, 9.21% of the total

Note: Standard error values in parentheses; ***, ** are 1%, 5% significant levels, respectively.

(1) Mediating effect test of economic scale-up

In this study, the economic scale-up effect is divided into two indicators: economic output density of urban land and investment intensity of urban construction land. Table 7 mainly reports the mediating roles of these two indicators for promoting economic development by ULUE. The coefficient of ULUE in Model (1) is significantly positive, indicating that improving ULUE will indeed increase the economic output density of urban land. When both ULUE and economic output density of urban land are included in Model (2) for estimation, the obtained coefficients of ULUE and economic output density of urban land are 0.243 and 0.329, and the coefficient of ULUE is decreased as compared with the coefficient of 0.398 in the baseline regression model, which indicates that the economic output density of urban land plays a partly mediating effect between ULUE and economic

development. The coefficient of ULUE in Model (3) is significantly negative, indicating that improving ULUE will reduce the investment intensity of urban construction land. When both ULUE and investment intensity of urban construction land are included in Model (4) for estimation, the obtained coefficients of ULUE and investment intensity of urban construction land are 0.518 and 0.116, and the coefficient of ULUE is increased as compared with that of the baseline regression model, which indicates that the nature of the indirect effect of investment intensity of urban construction land on ULUE and economic development is not a mediating effect, but a suppressing effect. Specifically, the indirect effect $\beta_1\theta_2$ has a negative sign, which is opposite to the positive sign of the regression coefficient θ_1 for ULUE. It can be seen that the positive driving effect of ULUE on economic development is obscured without controlling for the investment intensity of urban construction land, and the positive driving effect expands immediately once the variable is controlled. The above test results show that the hypothesis of mediating effect of H3a holds, and the action mechanism of economic output density of urban land between ULUE and economic development is a mediating effect. The hypothesis of mediating effect of H3b does not hold, and the action mechanism of investment intensity of urban construction land between ULUE and economic development is not a mediating effect, but a suppressing effect, and controlling the scale of fixed asset investment per unit of urban construction land will significantly enhance the positive driving effect of ULUE on economic development.

(2) Mediating effect test of economic structure optimization

In this study, the economic structure optimization effect is divided into two indicators: industrial structure and employment structure. Table 8 mainly reports the mediating role of these two indicators in promoting economic development by ULUE. The coefficient of ULUE in Model (1) is significantly negative, indicating that improving ULUE is not conducive to promoting industrial structure upgrading. This may be due to the generally low ULUE in the YRB, which has not yet developed a positive driving effect on industrial structure upgrading. When both ULUE and industrial structure are included in Model (2) for estimation, the obtained coefficients of ULUE and industrial structure are 0.369 and -0.904, respectively, and the coefficient of ULUE is decreased as compared with the coefficient in the baseline regression model, which indicates that the industrial structure plays a partly mediating effect between ULUE and economic development. It should be noted that industrial structure has a negative impact on economic development. This may be due to the fact that the YRB is still in the middle stage of industrialization, with a high proportion of resource and energy industries and heavy chemical industries, which is not conducive to the transformation and upgrading of industrial structure, and thus, hinders economic development. The coefficient of ULUE in Model (3) is negative, but it does not pass the significance test. It is further subjected to the Sobel test and the z-statistic is -4.063, indicating a significant indirect effect. When both ULUE and employment structure are included in Model (4) for estimation, the obtained coefficients of ULUE and employment structure are 0.387 and -0.556, respectively, and the coefficient of ULUE is decreased as compared with the coefficient in the baseline regression model, which indicates that the employment structure plays a partly mediating effect between ULUE and economic development. It should be noted that the employment structure has a negative impact on economic development. This may be due to the high number of resource-based cities in the YRB, which leads to a high proportion of employees in the secondary industry, which is not conducive to advanced employment structure, and thus, hinders economic development. The results of the above tests indicate that the hypotheses of the mediating effect of H4a and H4b are valid. Overall, economic structure plays a partial mediating effect between ULUE and economic development.

(3) Mediating effect test of economic quality enhancement

In this study, the economic quality enhancement effect is divided into three indicators: economic benefit, social benefit, and environmental benefit. Table 9 mainly reports the mediating role of these three indicators in ULUE driving economic development. The

coefficient of ULUE in Model (1) is positive, but it does not pass the significance test. It is further subjected to the Sobel test, and the z-statistic is 2.25, indicating a significant indirect effect. When both ULUE and economic benefit are included in Model (2) for estimation, the obtained coefficients of ULUE and economic benefit are 0.383 and 0.326, respectively, and the coefficient of ULUE is decreased as compared with the coefficient in the baseline regression model, which indicates that the economic benefit plays a partly mediating effect between ULUE and economic development. The coefficient of ULUE in Model (3) is significantly positive, indicating that an increase in ULUE widens the income gap between urban and rural residents. When both ULUE and social benefit are included in Model (4) for estimation, the obtained coefficients of ULUE and social benefit are 0.482 and −0.176, respectively, and the coefficient of ULUE is increased as compared with that of the baseline regression model, which indicates that the nature of the indirect effect of social benefit on ULUE and economic development is not a mediating effect, but a suppressing effect. Specifically, the indirect effect $\beta_1\theta_2$ has a negative sign, which is opposite to the positive sign of the regression coefficient θ_1 for ULUE. It can be seen that the positive driving effect of ULUE on economic development is obscured without controlling for social benefit, and once the variable is controlled for, the positive driving effect is swiftly expanded. The ULUE coefficient in Model (5) is significantly negative, indicating that improving ULUE will reduce wastewater emissions per unit of GDP, thus, contributing to the environmental benefit. When both ULUE and environmental benefit are included in Model (6) for estimation, the obtained coefficients of ULUE and environmental benefit are 0.362 and –0.0856, respectively, and the coefficient of ULUE is decreased as compared with the coefficient in the baseline regression model, which indicates that the environmental benefit plays a partly mediating effect between ULUE and economic development. The above test results show that the hypotheses of mediating effect of H5a and H5c hold, and the action mechanism of economic benefit and environmental benefit between ULUE and economic development is a mediating effect. The hypothesis of mediating effect of H5b does not hold, and the action mechanism of social benefit between ULUE and economic development is not a mediating effect but a suppressing effect, and controlling the income gap between urban and rural residents will significantly enhance the positive driving effect of ULUE on economic development.

5. Discussion

The evolutionary logic of the relationship between land resources and economic development shows that land resources are the core element of economic development. Economic development is inevitably constrained by a resource bottleneck, and how to solve the resource bottleneck constraint through efficiency improvement is the key to achieving sustainable economic development [36]. Undeniably, the importance of land resources to economic development varies from country to country, from region to region, and from stage to stage of economic development [60]. Most developed countries have entered the late industrialization and highly urbanized stage, where land use tends to stabilize and land resources have less impact on long-term economic development [61]. However, for regions in the same mid-industrialization and rapid urbanization stage, such as the YRB, land use change remains to be an important feature of economic development in the coming period, and land resources will have an important impact on long-term economic development. Therefore, regions in the mid-industrialization and rapid urbanization stages must fully consider the role of land resources on economic development and must consider how to achieve sustainable economic development through land use efficiency improvement. The evidence-based findings of this study can provide practical guidance for these regions to solve the dilemma of a lack of economic development momentum and inefficient land use, and can also provide a quantitative reference basis for the formulation of policies related to land use and economic development.

This study found that ULUE had a positive driving effect on economic development, which was consistent with the findings of Li et al. [1], Xie [30], and Xia [31]. In addition,

the study by Song et al. [34] has shown that geographic location differences and resource endowment differences affect regional ULUE. This study also confirms that the impact of ULUE on economic development is heterogeneous across cities with different geographic locations and resource endowments, with significant positive effects on midstream, downstream, and resource-based cities, while the effects on upstream and non-resource-based cities are not significant. It is worth noting that many studies have measured the economic development level by constructing a comprehensive index system from three dimensions: economic scale, economic structure, and economic quality [37,38], which indicates the existence of three paths of action of economic scale, economic structure, and economic quality in the interaction between economic development and other variables. Based on this theoretical view, in this study, we consider the economic scale-up effect, economic structure optimization effect, and economic quality enhancement effect as the three mediating mechanisms of ULUE affecting economic development. Another interesting finding is that economic scale-up, economic structure optimization, and economic quality enhancement do not all play mediating effects in the interaction between ULUE and economic development. Among them, the mechanisms of urban land economic output density and urban construction land investment intensity (economic scale variables) play a mediating effect and a suppressing effect, respectively; industrial structure and employment structure (economic structure variables) play a partial mediating effect; economic benefit and environmental/social benefit (economic quality variables) play a mediating effect and a suppressing effect, respectively.

It should be noted that there are some limitations associated with this study. First, in the process of ULUE affecting economic development, the economic scale-up effect, economic structure optimization effect, and economic quality enhancement effect may not work independently. The three paths of action may influence each other, cross-act, and ultimately affect economic development. Second, this study distills three mediating mechanisms of ULUE affecting economic development based on the general dimensions (economic scale, economic structure, and economic quality) constructed by the evaluation index system of economic development level. However, economic development is also related to economic base, welfare distribution, ecological environment, and other factors, which may also be intermediate mechanisms for ULUE to influence economic development.

6. Conclusions and Recommendations

In this study, we construct an analytical framework of the action mechanism of ULUE affecting economic development from three aspects: economic scale, economic structure, and economic quality, and we quantitatively examine its impact on economic development and the intermediate action mechanism on the basis of efficiency measurement. The main conclusions are as follows: (1) The results of the ULUE measurements show that the overall ULUE in the YRB shows a fluctuating upward trend, different types of cities show obvious differentiation characteristics, the spatial distribution characteristics of high- and low-value cities are obvious, and the radiation-driven effect among regional cities appears. (2) The baseline regression analysis shows that ULUE has a significant positive driving effect on economic development. (3) The heterogeneity regression analysis shows that the effect of ULUE on economic development is significantly heterogeneous among cities with different geographical locations and resource endowments, with significant positive effects on midstream, downstream, and resource-based cities, while the effects on upstream and non-resource-based cities are not significant. (4) The analysis of the action mechanism shows that there are two different mechanisms of mediating effect and suppressing effect between ULUE and economic development: The mechanisms of action of urban land economic output density and urban construction land investment intensity (economic scale variables) are the mediating effect and the suppressing effect, respectively; industrial structure and employment structure (economic structure variables) play part of the mediating effect; economic benefit and environmental benefit/social benefit (economic quality variables) are the mediating effect and a suppressing effect, respectively.

Based on the above research findings, the following policy recommendations are proposed: First, mediators should be used as a bridge to enhance the positive driving effect of ULUE on economic development. Specifically, the positive driving effect of ULUE on economic development can be promoted by enhancing the economic density of urban land, promoting the advanced industrial structure and employment structure, raising the wage level, and reducing the negative externalities of environmental pollution. Second, the suppressing effect of variables should be controlled to enhance the positive driving effect of ULUE on economic development. Specifically, the positive driving effect of ULUE on economic development can be promoted through controlling the scale of fixed asset investment, expanding effective investment, optimizing investment structure, and narrowing the income gap between urban and rural residents.

Author Contributions: Conceptualization, X.Z. and Y.L.; methodology, X.Z.; software, X.Z.; validation, X.Z.; formal analysis, X.Z. and Y.L.; resources, Y.L.; data curation, X.Z.; writing—original draft preparation X.Z.; writing—review and editing, Y.L.; supervision, Y.L.; project administration, Y.L.; funding acquisition, Y.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by National Key R&D Program Project: Ecological Restoration and Comprehensive Remediation Technology and Demonstration for Large Coal Power Bases in the Eastern Grassland Region (No. 2016YFC0501100) and the National Key R&D Program Project: Mine Safety Situation Analysis and Prediction and Early Warning System (No. 2017YFC0804408).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: The authors thank the anonymous reviewers for reviewing the manuscript. Thanks are extended also for the funding support from the project funding unit and the technical support from China University of Mining and Technology.

Conflicts of Interest: The authors declare no conflict of interest.

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